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Internet appliances permitting wireless Internet access and browsing, cellular telephones having Wi-Fi capability, as well as portable units or terminals that incorporate combinations of such functions.

[0035] The computer-readable memories 10B and 12B may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor based memory devices, random access memory, read only memory, programmable read only memory, flash memory, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The data processors DPs 10A and 12A may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and processors based on multi-core processor architectures, as non-limiting examples.

[0036] In accordance with the exemplary embodiments of this invention there are provided approaches for automatic seamless subscription remediation. These are referred to herein for convenience as Method 1 and Method 2.

[0037] Method 1: Subscription Remediation Through Connectivity Verification

[0038] The user device 10, which has earlier established a subscription with a Wi-Fi operator via the Wi-Fi network 1, is configured with the managed object (MO) 10E describing the properties of the subscription. The managed object 10E includes various data such as the credentials used for authentication, the URI of the remediation server, policies related to usage and data limits, etc. A non-limiting example of a managed object is shown in FIG. 3. Note the portion under Subscription Management, which includes Subscription Remediation and creation-related data (CreationDate, ExpirationDate, TypeofSubscription, usage limits, etc.

[0039] When the user device 10 attaches to an HS2.0 Wi-Fi network, for example, with which it has a subscription it authenticates itself using the credentials which are stored in the device 10 as part of the subscription profile. If the subscription has a problem, e.g., the policy requires the password to be changed, or the credit card on file has expired, then the subscription is in need of remediation.

[0040] In accordance with the exemplary embodiments, regardless of the problem or problems with the subscription, the Wi-Fi network 1 allows the user device 10 to connect to the network with the existing credentials. When the AAA (authentication, authorization and accounting) server 14 in the network validates the credentials, it sends an Access-Accept message back to the AP 12 with a success indication, but it also instructs the AP 12 to restrict access of the device 10 only to the Remediation Server 16.

[0041] The connection manager 10F of the device 10 then performs a connectivity test to a specific address. This test could be as simple as attempting to register with a default VoIP service provider (or, alternatively, trying to set up a VPN (virtual private network) connection). In addition, the connection manager 10F attempts to send an HTTP Request to a predetermined URI. In this latter action the connection manager 10F, or the OMA-DM client 10G in the device 10, sends an HTTP Request to a well-known URI. This URI used for testing the connectivity status could be a part of the attributes of the MO 10E or it could be embedded (hardwired into) the connection manager 10F. If the registration with the chosen VoIP service provider (e.g., Skype) or the establishment of the VPN connection is successful, and in addition, the device

receives an HTTP 200OK SUCCESS response to its HTTP Request, then the connectivity test can be considered successful, i.e., the device 10 has been authorized for connectivity to the Internet. Testing both HTTP and non-HTTP traffic may be required in order to overcome the configuration characteristics of some Wi-Fi Hotspots. For example, some Wi-Fi providers block all traffic except port 80 HTTP traffic. If both tests succeed it is indicated that the device 10 has been authorized for connectivity to the Internet and no (remediation or any other) action is needed. If the HTTP test succeeds, it may indicate that no remediation is necessary, but only HTTP traffic is allowed to pass. If both tests fail there is a clear indication that remediation is needed.

[0042] In accordance with an exemplary embodiment, if either of the foregoing tests fail it may be assumed that the reason for the failure is that subscription remediation is required. The AAA server 14 may have indicated in the ACCESS-Accept message to the AP 12 that the user who is attempting to obtain Internet access needs subscription remediation. The AP 12 then allows the device 10 to only connect to the subscription remediation server 16. If the connection manager 10F or OMA-DM client 10G realizes that association and/or authentication with the AP 12 succeeded, but one or both tests described above failed, it can presume that remediation is required.

[0043] The exemplary embodiments make an assumption that when a subscription is created (before the remediation step) that the subscription MO 10E will contain the URI of the subscription remediation server 14 in a leaf node that can be referred to as, for example, SubscriptionRemediationURI. When the OMA-DM client 10G (or a SOAP-XML client) in the device 10 realizes that subscription remediation may be needed generates an HTTP message to the URI found in the SubscriptionRemediationURI. This HTTP request will carry, for example, a package1 DM message (in the case of the OMA-DM client 10G). The subscription remediation server 16 responds with, for example, a package2 DM message with one of the following possibilities:

(A) If a password needs to be updated, it can send a Replace: subscriptionMO/ . . . /password DM command to the device 10, with the new value for the password (see FIG. 2A and the description of same below);

(B) If a client certificate needs to be renewed, and that requires the client to re-enroll into a new client certificate creation, then it may send a DM Execute: ClientCertCertEnrollment command to the device 10 (which will trigger the client to begin the certificate enrollment procedure and receive a new client certificate, see FIG. 2B and the description of same below); or

(C) If there is a problem with the account which requires user intervention (e.g., the credit card information needs to be updated), then the subscription remediation server 16 may send a DM command Execute:BrowsertoURI (see FIG. 2C and the description of same below). This triggers the device 10 to launch the browser application 10H and point it to the given URI, which will contain further instructions for the user. Note: that in case the device 10 uses SOAP-XML instead of OMA-DM, similar SOAP-XML objects are exchanged instead of OMA-DM objects.

[0044] In the first two possible response (A) and (B) the subscription is automatically remediated; and the device 10 will disassociate and associate with the new credentials to the network to obtain full Internet connectivity. The user of the device 10 does not need to perform any manual operations or